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Characterization of Silica-supported Rhodium Catalysts Prepared by Alkoxide Method and Particle Size Effect on Vapor Phase Hydroformylation of Ethylene

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Alkoxide techniques were employed to control the particle size of rhodium dispersed on silica. It was confirmed from the TEM observations that the particles in the reduced catalyst were in a uniform size level and the mean particle size could be adjusted in the range of 25-80 Å by changing the rhodium loading from 0.5 to 20.0 wt%. The EXAFS results showed that the rhodium ions were homogeneously dispersed in the gels obtained by a hydrolysis of the mixed solution of rhodium (III) nitrate dissolved in trimethylene glycol and tetraethyl orthosilicate, leading to a high uniformity of the particle size of rhodium. It was also found that the small metal particles were formed by drying and calcinating the gels and grew by reduction with hydrogen. The turnover number of the gas phase hydroformylation of ethylene grew by reduction with hydrogen. The turnover number of the gas phase hydroformylation of ethylene over the catalyst remarkably increased with a decrease in the metal particle size. (Fig.1) Deposition of carbons onto the surface of the catalyst was observed during the reaction, resulting in a significant reduction of the number of the active site for the reaction.

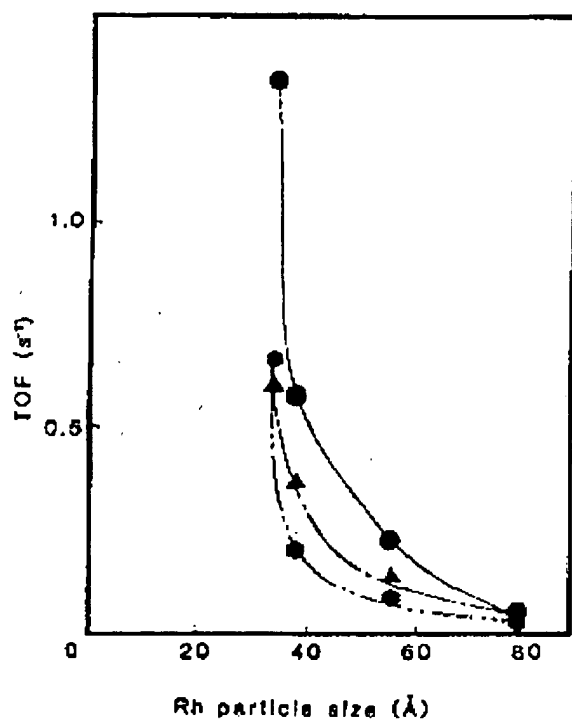


Fig. 1. Dependences of the turnover numbers of vapor-phase hydroformylation of ethylene on Rh particle size.

▲, Oxo Products; ■, Ethane; ●, Ethylene conversion

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